

Health Consultation

Evaluation of 2nd Round Indoor Air Sampling Results (November 2001)
Quincy High School
Quincy, Grant County, Washington

November 22, 2002

Prepared by

**The Washington State Department of Health
Under a cooperative agreement with the
Agency for Toxic Substances and Disease Registry**

The Washington State Department of Health (DOH) has prepared this health consultation in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR). ATSDR is part of the U.S. Department of Health and Human Services and is the principal federal public health agency responsible for health issues related to hazardous waste. This health consultation was prepared in accordance with methodologies and guidelines developed by ATSDR.

The purpose of this health consultation is to identify and prevent harmful human health effects resulting from exposure to hazardous substances in the environment. Health consultations focus on specific health issues so that DOH can respond quickly to requests from concerned residents or agencies for health information on hazardous substances. DOH evaluates sampling data collected from a hazardous waste site, determines whether exposures have occurred or could occur, reports any potential harmful effects, and recommends actions to protect public health. The findings in this report are relevant to conditions at the site during the time of this health consultation, and should not necessarily be relied upon if site conditions or land use changes in the future.

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Glossary

Acute	Occurring over a short period of time. An acute exposure is one which lasts for less than 2 weeks.
Agency for Toxic Substances and Disease Registry (ATSDR)	The principal federal public health agency involved with hazardous waste issues, responsible for preventing or reducing the harmful effects of exposure to hazardous substances on human health and quality of life. ATSDR is part of the U.S. Department of Health and Human Services.
Carcinogen	Any substance that can cause or contribute to the production of cancer.
Chronic	A long period of time. A chronic exposure is one that lasts for a year or longer.
Comparison value	A concentration of a chemical in soil, air, or water that, if exceeded, requires further evaluation as a contaminant of potential health concern. The terms comparison value and screening level are often used synonymously.
Contaminant	Any chemical that exists in the environment or in living organisms that is not normally found there.
Dose	A dose is the amount of a substance that gets into the body through ingestion, skin absorption, or inhalation. It is calculated per kilogram of body weight per day.
Exposure	Contact with a chemical by swallowing, by breathing, or by direct contact (such as through the skin or eyes). Exposure might be short-term (acute) or long-term (chronic).

Groundwater	Water found underground that fills pores between materials such as sand, soil, or gravel. In aquifers, groundwater often occurs in quantities where it can be used for drinking water, irrigation, and other purposes.
Hazardous substance	Any material that poses a threat to public health and/or the environment. Typical hazardous substances are materials that are toxic, corrosive, ignitable, explosive, or chemically reactive.
Media	Soil, water, air, plants, animals, or any other part of the environment that can contain contaminants.
Model Toxics Control Act (MTCA)	The hazardous waste cleanup law for Washington State.
No apparent public health hazard	Sites where human exposure to contaminated media is occurring or has occurred in the past, but the exposure is below a level of health hazard.
Organic	Compounds composed of carbon, including materials such as solvents, oils, and pesticides, which are not easily dissolved in water.
Parts per billion (ppb)/parts per million (ppm)	Units commonly used to express concentrations of contaminants. For example, 1 ounce of trichloroethylene (TCE) in 1 million ounces of water is 1 ppm. One ounce of TCE in 1 billion ounces of water is 1 ppb. If 1 drop of TCE is mixed in a competition size swimming pool, the water will contain about 1 ppb of TCE.
Plume	An area of contamination in a specific media such as groundwater.

**Volatile organic
compound (VOC)**

An organic (carbon-containing) compound that evaporates (volatilizes) easily at room temperature. A significant number of the VOCs are commonly used as solvents.

Background and Statement of Issues

The Washington State Department of Health (WDOH) has prepared this health consultation in response to concerns expressed by the Quincy School District and several community members about the impact on indoor air quality at Quincy High School from the potential migration of volatile organic compounds (VOCs) from area groundwater. This health consultation is a follow-up to a previous health consultation prepared by the Agency for Toxic Substances and Disease Registry (ATSDR) that found no apparent public health hazard based on their evaluation of indoor air samples collected in August 2000 at Quincy High School and two background schools.¹ This health consultation evaluates the results of a similar indoor air quality investigation conducted in these same schools in November 2001.

Quincy is a small farming community, located in the Columbia Basin in east-central Washington. It is a heavily irrigated, agricultural region producing apples, wheat, potatoes, alfalfa, and vegetables. The high school is situated in a mixed industrial and residential area in the north part of Quincy, near the Cenex facility (Figure 1). The Cenex facility is a hazardous waste site being investigated and cleaned up under the authority of the Washington State Model Toxics Control Act (MTCA). There is a history of spills and releases of fumigants and pesticides into the soil and groundwater on the Cenex property. A contaminated groundwater plume, containing elevated levels of 1,2-dichloropropane (1,2-DCP) and other volatile organic compounds (VOCs), has migrated southeast from the site, and underneath a portion of the high school.

Community and school district concerns about the impact of the groundwater plume on the high school's indoor air quality prompted limited indoor air sampling at the high school in February 1998. Samples were analyzed for 1,2-DCP, the primary groundwater contaminant. Eleven 3-M passive organic vapor monitors were used to collect the air samples; nine inside the school and two outside the school. A low concentration of 1,2-DCP was detected in one of the rooms (the teacher's lounge) and was evaluated in a public health assessment prepared by WDOH. WDOH concluded that the low level of 1,2-DCP detected did not pose a public health hazard. As a precautionary measure, WDOH recommended follow-up indoor air sampling using a more appropriate and sensitive test method.² The Washington State Department of Ecology (Ecology) and the Quincy School District also requested follow-up on this issue.

The first of two, more comprehensive follow-up indoor air quality investigations was conducted at the Quincy High School and two background schools (Pioneer Elementary and the Alternative High School) in August 2000. The two background schools were selected in order to measure indoor air in the community away from the general location of the Cenex groundwater plume. ATSDR evaluated the results of the August 2000 indoor air quality investigation in a health consultation. ATSDR concluded that the concentrations of chemicals detected in air at the Quincy High School and background schools do not pose a public health hazard, but recommended more sampling during a different season to confirm previous results and to determine whether air quality in the school is different during the fall/winter season.¹

In November 2001, follow-up indoor air samples were collected at the high school and the two background schools. The sampling protocols and locations used during the August 2000 indoor air sampling event were repeated during the November 2001 sampling event. Quincy High School and Pioneer Elementary have active, buildingwide ventilation systems that continuously move outside air into the building. The ventilation system at the Alternative High School was not operating at the time of the sampling. To reduce the likelihood that the samples might be accidentally contaminated by building maintenance or cleaning chemicals, maintenance personnel were contacted and signs were posted on each of the rooms directing anyone who wished to enter the room to contact the Quincy School District. Door locks also were taped. The sampling occurred during the Thanksgiving holiday break.^{3, 4}

The sampling locations in the high school were selected for the following reasons:³

1. Room 724 has an active hatch that leads to an abandoned steam tunnel. The steam tunnel is the low point in the high school, and is the most likely point of entry for subsurface gases from the soil into the indoor air.
2. Room 729 is located near the boiler room that connects to the abandoned steam tunnel.
3. Room 807 is adjacent to a janitor's closet, within which is an opening to the abandoned steam tunnel.
4. Room 703 used to be a teacher's lounge, where a low level of 1,2-DCP was detected during the previous, limited indoor air investigation in 1998.

The air samples collected at Pioneer Elementary and the Alternative High School were intended to provide background contaminant levels in indoor air for comparison to those found at the high school.

Stainless steel SUMMATM canisters were used to collect the samples over a 48-hour period. The samples were analyzed according to EPA method TO-14, which included approximately 60 chemicals on the standard TO-14 list, plus several hundred other organic chemicals on an extended list.³

Background

Background is defined here as the amount of VOCs expected to be present in air without any known contribution from a particular source. Since VOCs are expected to be present in urban indoor and outdoor air, it is useful to estimate what the expected level is in order to determine whether levels are higher due to an identified source. The levels measured in Quincy High School indoor air and the background schools are most likely related to their widespread use and presence in the environment, and not any particular source.

Sampling results

Four chemicals (acetaldehyde, acetonitrile, acrolein, and acrylonitrile) were present above their respective health comparison values in one or more rooms, and were further evaluated. The highest levels of these four chemicals detected during both sampling events were detected in Pioneer Elementary, one of the two background schools. Two of the chemicals (acetonitrile and acrylonitrile) were only detected in Pioneer Elementary. Low levels of other chemicals were detected during the investigation, but below environmental and/or occupational health levels of concern, or below background levels commonly found in urban ambient and indoor air. None of the detected chemicals are associated with the Cenex site, including the groundwater plume.

Comparison Values

The fact that an air contaminant exceeds a health comparison value does not mean that a public health hazard exists, but rather signifies the need to evaluate the chemical further. Due to the presence of common sources such as automobile exhaust, pesticides, tobacco smoke, cleaning products, industrial emissions, etc., it is not uncommon for background levels of some chemicals in air to exceed health comparison values.

Table 1 below gives the maximum concentrations of the four chemicals that exceeded comparison values. EPA's inhalation reference concentrations (RfCs) are used as comparison values. Also presented in Table 1 are estimates of background concentrations for each of these four chemicals expected to be present in indoor air. Complete results of the four chemicals that exceeded comparison values during the November 2001 sampling event are provided in Appendix A, Table A1.

Table 1. Chemicals exceeding comparison values
(units are in micrograms per cubic meter)

Chemical	Maximum concentration ¹	RfC	Adjusted RfC ²	Background
acetaldehyde	13.2	9	72	9.6 (range: 4 - 70)
acetonitrile	1,377	60	480	4 - 12
acrolein	10	0.02	0.16	0.023 - 0.11
acrylonitrile	82	2	16	2.1

1 The highest concentration of all four chemicals was from Pioneer Elementary, a background school.

RfC = EPA reference concentration (for chronic exposures).

2 The RfC is adjusted to account for an 8-hour exposure period per day versus a 24-hour exposure assumed by EPA when deriving the RfC.

3 Acetonitrile and acrylonitrile were only detected during the November 2001 sampling event at Pioneer Elementary.

Discussion

Chemicals evaluated in this health consultation are presented in Table 1. The November 2001 sampling results were similar to the August 2000 sampling results. In some cases, a chemical was detected in a room during the first sampling event, but not the second. In other cases, a chemical was detected in a room during the second sampling event, but not the first. For example, acetonitrile and acrylonitrile were not detected in Pioneer Elementary during the first sampling event, but were detected during the second sampling event. Acrolein and acetaldehyde were detected in Quincy High School Room 807 during the first sampling event, but not the second. The following section discusses the four chemicals in more detail.

Acetaldehyde

Acetaldehyde is widely used in pesticides in irrigation areas and is a product of internal combustion engines, tobacco smoke, and power plants using fossil fuels, wood, or trash. It is also used in foods as a flavoring agent and as a preservative. Motor vehicle tailpipe emissions are large emission sources, although local industrial sources might contribute to acetaldehyde levels. As a result of its widespread use, acetaldehyde has been measured at low levels in ambient and indoor air throughout the United States.^{5,7} Typical ambient background levels are reported to range from 2 to 39 ppb (4 to 70 µg/m³).

Low concentrations of acetaldehyde in indoor air were detected in one room at Quincy High School, and in the two background schools during the November 2001 sampling event. Levels ranged from 2.4 parts per billion (ppb) to 7.3 ppb. Acetaldehyde was also detected in the associated sample analysis blanks. Acetaldehyde is not a chemical associated with the Cenex site.

Acetaldehyde is a skin, eye, and respiratory irritant at much higher levels than those detected in the schools. EPA's inhalation reference concentration (RfC) is based upon degeneration of olfactory epithelium observed during high dose rat inhalation studies.⁶ The concentrations of acetaldehyde detected in indoor air in the schools was below the RfC (adjusted to account for the less than 24-hour, 7-days/week exposure duration), indicating that adverse noncancer health effects are not expected. Although it has not been proven to cause cancer in humans, EPA considers acetaldehyde a probable human carcinogen, on the basis of inadequate human data and sufficient animal data.^{5,6} The levels of acetaldehyde detected in indoor air were well below the levels that produced cancer in the relevant laboratory animal studies.

Acetonitrile

Acetonitrile is widely used as a solvent and catalyst. It is also used as a chemical intermediate in pesticide manufacture, is found in tobacco smoke, and is a product of internal combustion engine exhaust.⁵ Because of its widespread use, it has been measured at low levels in ambient air throughout the U.S.⁷ Typical ambient background levels are reported to range from 4 to 12 µg/m³.

Acetonitrile was only detected once, at Pioneer Elementary School during the November 2001 sampling event. It was not detected during the previous sampling event at Pioneer Elementary, nor in any other location tested, indicating the likelihood that the detection was an isolated, short-term event. Acetonitrile is not a chemical associated with the Cenex site.

Respiratory effects, such as dizziness, headache, and weakness have been reported after exposure to high levels of acetonitrile in the workplace. The RfC is based upon mortality of rodents after exposure to very high levels of acetonitrile.⁶ Although the single detection at Pioneer Elementary exceeded the EPA reference concentration (adjusted), it was 244 times lower than the highest level that did not result in the types of health effects discussed above. The detected concentration was also 44 times lower than the highest level that did not result in short-term health effects observed in rodent studies.⁶ As a result, adverse noncancer health effects would not be expected.

Although EPA cannot classify acetonitrile as to its carcinogenicity, studies strongly suggest that the carcinogenic potential of acetonitrile is low.⁶

Acrolein

The major source of acrolein in the environment is the combustion of organic material, such as gasoline and other petrochemical fuels. Acrolein is used as a rodenticide, fungicide, and herbicide to control the growth of aquatic weeds in irrigation waterways, and as a chemical intermediate. It is also used in the manufacture of pharmaceuticals, perfumes, food supplements, and resins, and is a by-product of wood and tobacco smoke.^{5,8} Typical ambient background levels are reported to range from 0.02 to 0.1 µg/m³.

Low levels of acrolein were detected in all but one of the indoor air samples collected during the November 2001 sampling event. It was also detected in the associated sample analysis blanks. As a result of its widespread use, acrolein has been measured at low levels in ambient air throughout the United States. The low levels measured in indoor air in the school rooms are most likely related to the chemical's widespread use and presence in the environment. Acrolein is not a chemical associated with the Cenex site.

The most sensitive effect observed in humans after exposure to acrolein is eye irritation, whereas the most sensitive effect observed in animals is respiratory irritation. The reference concentration (RfC) is based on cellular changes and inflammation in the lining of the nasal cavity observed in rats exposed to acrolein in air for several weeks at a level 1,000-times higher than the RfC itself.⁶ Although the levels detected in indoor air at the schools exceeded the RfC, they were over 20 times lower than the lowest levels that produced these effects in the rodent study discussed above. This comparison suggests that long-term exposure to the relatively low levels of acrolein measured in indoor air at the schools is not high enough to cause these chronic respiratory effects. Although acrolein is considered by the EPA to be a possible human carcinogen, the levels that produced cancer in the relevant laboratory rodent studies were thousands of times higher than the levels measured in the rooms sampled, indicating that exposures are not expected to result in the development of cancer.

Acrylonitrile

Acrylonitrile is used in the plastics, surface coatings, acrylic fiber, synthetic rubber, and adhesives industries. It is used as a chemical intermediate in the synthesis of antioxidants, pharmaceuticals, and dyes, and as a pesticide fumigant for stored grain.^{5,9} As a result of its widespread use, acetaldehyde has been measured at low levels in ambient and indoor air throughout the United States.

Like acetonitrile, acrylonitrile was only detected in air at Pioneer Elementary during the November 2001 sampling event. It was not detected during the previous sampling event at Pioneer Elementary, nor in any other location tested, indicating the likelihood that the detection was an isolated, short-term event. Acrylonitrile is not a chemical associated with the Cenex site.

The RfC is based upon the degeneration and inflammation of nasal respiratory epithelium and hyperplasia of mucous secreting cells observed during a 2-year inhalation study on rats.⁶ Although the single detection of acrylonitrile exceeded the RfC, the level detected was more than 90 times lower than the lowest level that produced these effects in the inhalation study that was the basis of the RfC. Human volunteers exposed acutely (8 hours) to acrylonitrile at concentrations of 5,400-10,900 $\mu\text{g}/\text{m}^3$ (2,400-5,000 ppb) exhibited no adverse effects.⁶ Although it has not been proven to cause cancer in humans, EPA considers acetaldehyde a probable human carcinogen. Exposure to the level detected at Pioneer Elementary is well below levels that produced cancer in the relevant toxicity studies. As a result, exposures to the level detected in Pioneer Elementary would not be expected to result in the development of cancer.

Child Health

ATSDR's Child Health Initiative recognizes that the unique vulnerabilities of infants and children deserve special emphasis concerning exposures to environmental contaminants. Infants, young children, and the unborn might be at greater risk than adults from exposure to particular contaminants. Exposure of the fetus and developing child might lead to adverse health effects, ranging from birth defects to subtle changes in behavior and learning.

After birth, children might receive greater exposures to environmental contaminants than adults. Pound-for-pound of body weight, children drink more water, eat more food, and breathe more air than adults. Therefore, a child will inhale a higher dose of contaminants present in air.

Exposure to the chemicals detected in indoor air were well below levels that can cause the more sensitive reproductive and developmental effects noted in the relevant toxicity studies.

Conclusions

1. On the basis of the results of the indoor air sampling, there is no evidence of migration of chemicals from the Cenex groundwater plume to indoor air at Quincy High School.
2. Chemicals detected in indoor air at Quincy High School and the two background schools during November 2001 were similar to those detected in August 2000. None of the detected chemicals are associated with the Cenex site, including the groundwater plume.
3. Four chemicals (acetaldehyde, acetonitrile, acrolein, and acrylonitrile) were detected in indoor air at levels exceeding their respective health comparison value(s), and were further evaluated.

The highest concentrations of each of these chemicals were found at Pioneer Elementary, one of the two background schools. Two of these chemicals (acetonitrile and acrylonitrile) were only found in Pioneer Elementary during the November 2001 sampling event, indicating the likelihood that they were short-term events most likely related to the types of common background sources described in the Discussion section.

4. As a result of their widespread use in the environment, these chemicals have been measured at low levels in ambient and indoor air throughout the United States. The levels measured in indoor air in the schools are most likely related to their widespread use and presence in the environment, and not any particular source.
5. The concentrations of chemicals detected in indoor air at Quincy High School and the background schools are not at levels expected to result in acute or chronic adverse health effects, and pose no apparent public health hazard.

Recommendations/Action Plan

1. WDOH should be notified if groundwater conditions change that could potentially increase the chance of VOC migration into indoor air at Quincy High School.
2. The Pioneer Elementary School indoor air sampling results from November 2001 showed elevations in some chemicals commonly found in ambient and indoor air. While this result does not indicate a significant health risk, the school should take steps to ensure that good housekeeping practices, designed to minimize indoor air contamination, are being followed.

Actions:

1. DOH will provide information to the Pioneer Elementary School regarding good housekeeping practices designed to minimize indoor air contaminants.
2. Housekeeping practices should include:
 - a. Adequate walk-off mats that are cleaned regularly.
 - b. Routine cleaning of all flooring surfaces, carpets, and tile.
 - c. Routine change of air handler filters with upgrade to 30% efficient extended surface pleated filters.
 - d. Have the building pressure differentials checked. The building should maintain positive pressure in relation to ambient air.
3. Tim Hardin, health advisor with the WDOH Indoor Air Quality Program, is available to discuss these recommendations with the appropriate school staff.

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References

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Appendices

Table A1. Chemicals detected in indoor air at Quincy High School that exceed health comparison values *

(units are in micrograms per cubic meter)

Chemical	Quincy High School (room number)				Comparison (background) schools	
	703	729	724	807	Alternative High School	Pioneer Elementary
acetaldehyde	ND	ND	4.3 (B, J)	ND	6.2 (B, J)	13.2 (B, J)
acetonitrile	ND	ND	ND	ND	ND	1377
acrolein	5.7 (B)	8.5 (B)	8.9 (B)	ND	7.3 (B)	10 (B)
acrylonitrile	ND	ND	ND	ND	ND	82

* Low levels of other chemicals, also not related to the Cenex site, were detected below health comparison values, below occupational exposure levels, and/or below background levels.

ND = not detected

B = chemical also was detected in the sample analysis blank

J = estimated value

Certification

This Health Consultation was prepared by the Washington State Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.

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